PCD Beam Blanker
JEOL SEM's

Operation & Installation
Manual V4.3
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CONTENTS

WARNING!

SUPPLY VOLTAGE is 100V only

Supply voltage should be taken from the SEM power supply (100V) not from a normal wall socket, see: IMPORTANT NOTES, page 3

CONTINUOUS OPERATION

We do not recommend continuous operation for more than one hour with blanking voltage in excess of 300V and clock frequency close to 1MHz as some over-heating may occur.

Introduction

Please read this manual and understand all operation and installation instructions before proceeding. If you are unsure about any item please contact Deben UK Ltd before proceeding for technical assistance.

Read the notes on page 4 before installing the system.

The DEBEN PCD blanking system has been designed to provide SEMs with the capability of blanking, pulsing or otherwise modulating the electron beam.

Typical applications for this unit include electron beam-induced conductivity (EBIC), cathodoluminescence, voltage contrast, electron beam writing and lithography, electron acoustic microscopy and X-Ray microanalysis.

PCD Blanker fitted to JSM-840 & JSM-5900 column

The unit is designed to be operated at HT voltages from 500V to 40KV and will switch the beam on or off, typically in 50ns periods.

Beam blanking is achieved by deflecting the electron beam away from the central axis of the column using a set of deflection plates. These deflection plates are fitted into the PCD port, which is directly opposite the final objective aperture. The deflection plates sit directly below the aperture assembly and are gold plated.

Important notes

Take care and read the installation instructions fully, before installing equipment onto JEOL SEM 100V outlet connectors

Power

IMPORTANT

Power should be taken from the SEM 100V supply located at the rear of the accessory rack.

DO NOT PLUG THE BLANKING SYSTEM INTO A STANDARD 110V SUPPLY.

The supply voltage for the blanking system should be 95-105VAC at 50/60Hz

If the primary of the JEOL transformer is wired incorrectly it is possible that there is a 240V difference between the microscope chassis ground on the SEM and the Live or Neutral lines.

Before installing any equipment to the JEOL 100V outlets on the SEM, always check that there is not 240V between Neutral and the microscope chassis ground or Live and microscope chassis ground.

Check with a DVM as shown on the next page. Live to Ground should be approximately 100V and Neutral to ground should be less than 5V.

If you measure 200V or more then check the transformer wiring before connecting any equipment.

Correct reading: Neutral to Ground (less than 5V)

Correct reading: Live to Ground (approx. 100V)

Continuous Operation

We do not recommend continuous operation of more than one hour with blanking voltages of more than 300V or clock frequencies of more than 1Mhz, as some over-heating may occur.

Operation

All functions of the PCD blanker are controlled from the small keypad controller. Current status is displayed along with the blanking voltage if applicable.

Plate position & plate voltage

The blanking plates can be positioned in one of three locations (OUT, PCD, BLANK), using the plate position controller keys.

Once located, the plate position may be adjusted for optimum blanking and optimum probe current detection using the arrow keys labeled “PLATE POSITION”.

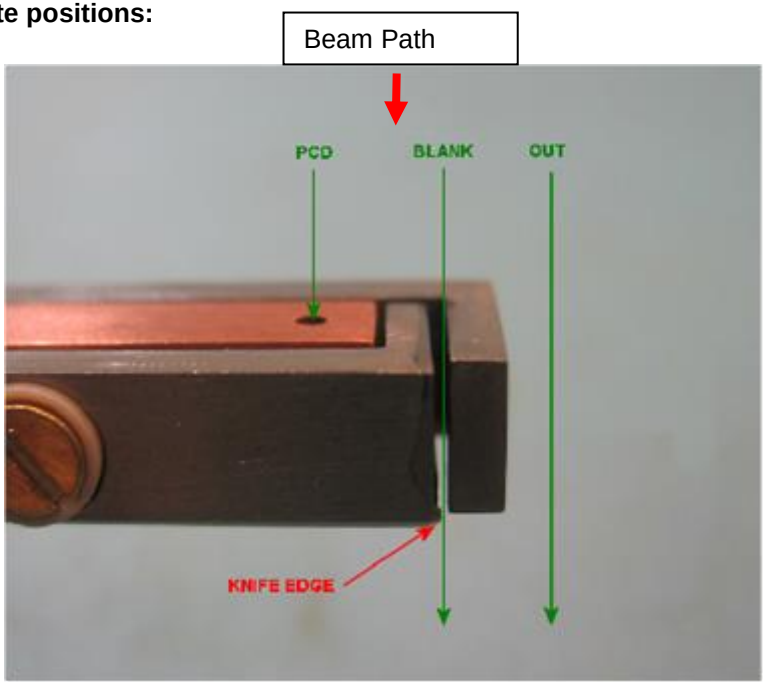
It is important to save this optimum plate position to memory:

Press “SETUP” once to display “Save position?

Press “Enter” to save.

The plate positions are shown below:

Plate positions:



Beam status

With the deflection plates in the blank position, there are three different modes of operation;

1. Beam-On
2. Beam-Off
3. Beam-Blank

Beam-On means that there is no voltage applied to the plates so the SEM image should appear as normal.

Beam-Off means that the beam is switched off or fully blanked; the deflection voltage is applied as a constant signal (un-modulated).

Beam-Blank means that the beam will be blanked by TTL, the signal applied to the pulse input at the rear of the power supply box.

With the plates in the **BLANK** position and beam status selected at Beam-Blank or Beam-Off, the plate voltage may be adjusted between 0V and 300V (400V optionally, see page 20).

Normally for correct blanking at 1KV, only 40-50V will be necessary, but higher voltages are required for blanking at up to 40KV or for very high beam currents.

On the controller pad, pressing the up arrow increases the blanking voltage and the down arrow decreases the blanking voltage.

Blanking operation

For first time use, refer to “Appendix – A - Installation”, on page 24 or if the blanking positions are lost, see the section on “Lost plate position”, page 10.

For optimum blanking, the beam should travel for the shortest distance before hitting the deflection plates.

The plates are spaced 0.5mm apart and the outer plate (closest to the PCD unit) has a 0.25mm "knife edge" built into the bottom, which acts like an aperture in cutting off the beam. This gives a nominal beam path of around 0.25mm.

To find the ideal blanking position:

1. Press BLANK and the plates will move into the blanking position.
2. Press the PLATE POSITION right arrow key and move the plates until the image disappears.
3. Move the plates back using the left arrow key, until the image re-appears.
4. Using the left arrow again, move the plates an additional 0.125mm. The plates will now be in the optimum blanking position.

   It is important to save this optimum plate position to memory:

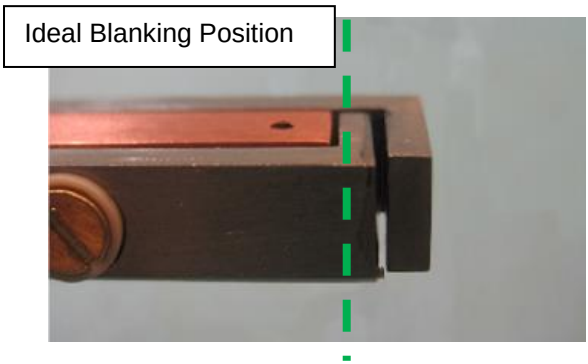
   Press “SETUP” once to display “Save position?

   Press “Enter” to save.
5. Press BEAM OFF then BEAM ON with the voltage set to at least 100V to make sure that the beam can be correctly switched.

The blanking pulse input is on the rear of the power supply and accepts a +5V TTL signal. The maximum switching frequency is 1.2MHz; this maximum is electronically limited within the power supply to prevent overheating. See setup instructions on page 20 for instructions on inverting this input signal.

Lost plate position

If you lose the blanking or PCD position, follow these instructions to reset the coordinates.



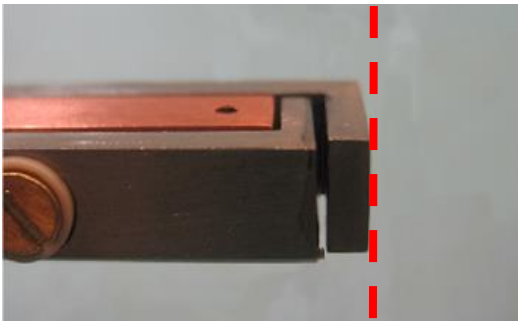
1. Turn the electronics off and wait 30 seconds.

2. Press and hold the PLATE VOLTAGE down arrow button and switch on the electronics with the blanker head unit connected. “Resetting…” will flash on the display once.

3. Press PLATE POSITION - BLANK, and then ENTER.

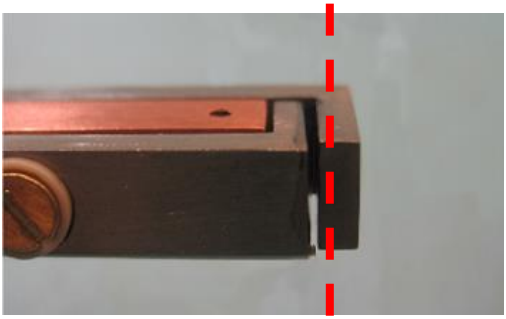
4. Use the **left** PLATE POSITION arrow to move the plates to a position until the image is continuously visible.

   The beam is now in this position, outside the plates:



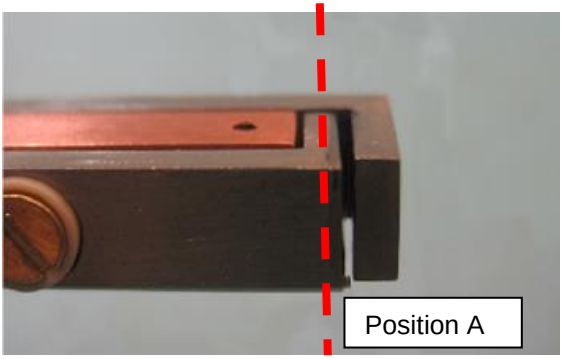
5. Use the **right** PLATE POSITION arrow to move the plates until the image just disappears.

   The beam is now in this position:



6. Use the **right** PLATE POSITION arrow to move the plates until the image just appears.

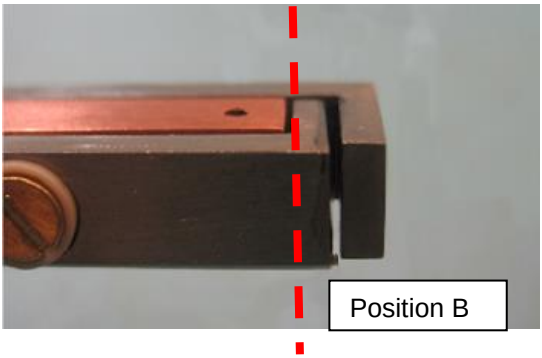
   The beam is now in this position: (Position A)



7. Record the position of this point from the controller display. To display the position, press the right arrow once.

8. Use the **right** PLATE POSITION arrow to move the plates until the image just disappears.

   The beam is now in this position: (Position B)



9. Record the position of this point from the controller display. To display the position, press the right arrow once.

   The ideal blanking position is located between the two plates. The distance that the plates must move to reach the ideal blanking position can now be calculated.

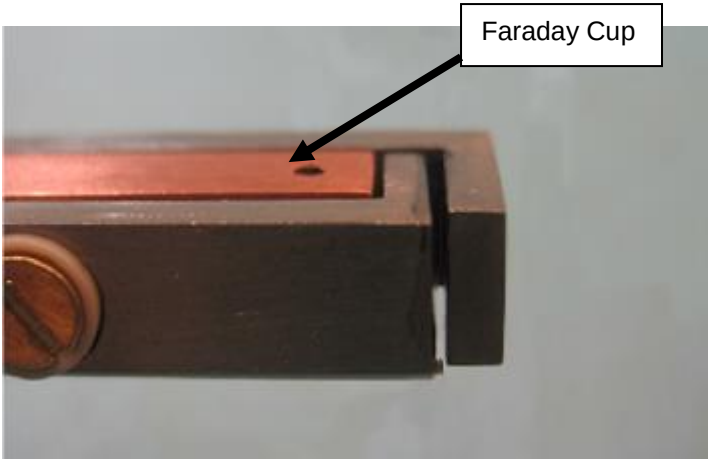
   Distance = (Position A – Position B) / 2

   Use the **left** PLATE POSITION arrow to move the plates by this distance.

10. To complete this step, press SETUP, to display “Reset cords”, followed by ENTER pressed twice. This will set the current position to 6.000mm. The PCD and out positions will also be reset to the default values.

PCD operation

The integrated Faraday Cup allows beam current to be monitored.



Select PCD on the controller pad. This will move the Faraday Cup to the optimum measurement position. (Nominally 10.000mm) Centre the Faraday Cup using the PLATE POSITION arrow keys so that the maximum current reading is achieved.

It is important to save this optimum plate position to memory:

Press “SETUP” once to display “Save position?

Press “Enter” to save.

There are two modes of operation to take a current reading: Internal and External.

Internal mode allows current to be read using the Deben display and this can be calibrated by using an external Pico ammeter as described on page 19.

External mode allows for connection of an external Pico ammeter to the BNC connector at the rear of the blanking unit.

To switch between internal and external mode, use the switch at the rear of the blanking unit (See above); down will select external while up selects internal.

The internal reading is low resolution and for reference only, for analytical measurements we recommend the connection of an external Pico ammeter.

SETUP

The red SETUP button may be pressed in any mode. Within setup there are six options. Repeatedly press SETUP to scroll between options. Available options are:

1. Save position? – Saves current plate position for active mode (OUT, PCD or BLANK) into memory.

2. Reset coords? – Resets all the origins of the coordinate system.

3. Cal PCD? – Calibrates the internal PCD reading against an external Pico ammeter.

4. Invert blank? – Inverts the external blanking signal.

5. Set max blank? – Changes the maximum blanking voltage from 300V to 400V.

6. Set options? – Allows the system to be configured.

To select each option, toggle through the menu by pressing SETUP and then press ENTER to select.

1. Save position?

If using the “Plate Position” arrow keys to find an optimum plate position, this position can be saved.

1. Use “Plate Position” arrow keys to finely adjust the plate position to the required position. The plate position can be finely adjusted in all modes (OUT, PCD and BLANK).

2. Press “Setup” once. “Save position?” will display.

3. Press “Enter” once. If “Enter” is not selected, the position will fail to save.

2. Reset Coords?

Depending where the plates are positioned the coordinates can be reset. The default values are as follows:

Out: 0.000mm

PCD: 10.000mm

Blank: 6.000mm

If you centre the faraday cup for the highest reading and then reset the coordinates, the PCD position will be reset to 10.000mm and blanking to 6.000mm. If you setup the blanking position and then select reset, the blanking position will be set to 6.000mm and PCD to 10.000mm. So the origins for the coordinate system can be set up either from the correct blanking position of the correct PCD position.

In use the ideal blank and PCD positions are not always 4mm apart so it is suggested that the blank position is set as default. Then when the PCD button is pressed for the first time, it can be adjusted for optimum position with the plate position arrow keys.

It is important to save this optimum plate position to memory:

Press “SETUP” once to display “Save position?

Press “Enter” to save.

3. CAL PCD?

Use the following procedure to calibrate the internal PCD reading to a Pico ammeter:

1. Position the plates in the PCD position and centre the faraday cup.

2. Set the beam current to a known value such as 1.00nA, with the value displayed on the external Pico ammeter.

3. Switch the mode to Internal using the selector switch at the rear of the blanking unit; if the value is not reading correctly select CAL PCD. 100 is the centre value (no adjustment).

4. Adjust the calibration number using the up/down arrow keys and then press Enter; a lower number will decrease the reading and a higher number will increase it.

5. It is recommended to try a few different values until you get the internal display reading 1.00nA as well. The value will be automatically saved.

4. Invert blank?

The external blanking signal can be inverted if necessary.

1. Select SETUP, Invert blank and press ENTER.

2. Use the up/down arrow keys to select normal or inverted.

3. Pressing ENTER again will save the new condition. This will change the +5V input from blanking the beam to un-blanking the beam.

5. Set max blank?

Some applications may require a voltage higher than 300V to fully blank the beam; in this case it is possible to set the blanking voltage to a maximum of 400V.

To change the maximum blanking voltage

1. Press SETUP, Set max blank, then ENTER.

2. Use the up/down arrow keys to change the maximum blanking voltage from 300V to 400V.

3. As a safety feature the maximum blanking voltage reverts to 300V once the system power has been switched off and on again.

6. Set options?

This setting should not be changed unless directed to do so by Deben UK Ltd

The first option shows either ‘PB not installed’ or ‘PB installed’ on the bottom line of the display.

For most systems, this should show ‘PB not installed’. PB stands for protection board.

The next screen shows ‘PCD reset=10mm’ or ‘PCD reset=4mm’ on the bottom line of the display. This changes the default value that is used for PCD position during a coordinate reset and should be set to ‘10.000mm’. **Again, this setting should not be changed unless directed to do so by Deben UK Ltd.**

Command summary

Plate position

out Moves plates to out position which clears the beam

PCD Moves plates to PCD reading position,

blank Moves plates to the blanking position

Beam status (when in blank position)

on Switches off the blanking voltage

off Switches on the blanking voltage continuously to blank the beam

blank Blanks the beam in time with the pulse applied to the rear of the power supply unit

Setup/Enter

Save position? – Saves current plate position for active mode (OUT, PCD or BLANK) into memory.

Reset Coords? – Resets the origin of the coordinate system to the current selected position.

CAL PCD? – Calibrates the internal PCD reading against an external Picoammeter.

Invert blank? – Inverts the external blanking signal.

Set max blank? – Changes the maximum blanking voltage from 300V to 400V.

Set options? – Allows the system to be configured.

Enter Accepts setup information

Plate voltage up/down arrows

Up In blanking position – increases blanking voltage

In PCD calibrate position – increases PCD reading

Down In blanking position – decreases blanking voltage

In PCD calibrate position – decreases PCD reading

Plate position left/right arrows

left Retracts the plates out of the beam axis

right Extends the plates into beam axis

Appendix – A - Installation

JEOL – All JEOL SEMs

Note:

It is recommended to take a calibration picture on the SEM prior to installation to ensure that no reduction in image quality is evident after installation.

1. If fitted, close the column isolation valve.

2. Vent the vacuum chamber to air.

3. Remove the blanking flange from the PCD port.

   Note:

   If there is a column cover fitted to the SEM, this will need to be removed to access the PCD port.

4. Connect the blanking system with the cables provided, but do not fit to the SEM yet.

IMPORTANT

Power should be taken from the SEM 100V supply.

This power supply is located at the rear of the accessory rack.

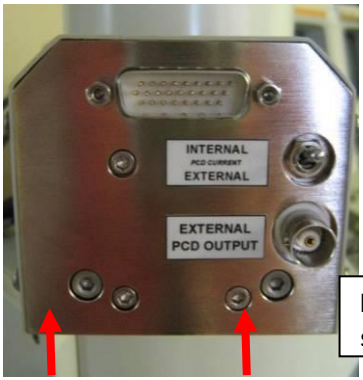
DO NOT PLUG THE BLANKING SYSTEM INTO A STANDARD 110V SUPPLY.

5. Switch on the blanking system. The Deben display will turn on. The following message should be displayed:

6. Leave the system switched on for at least 30 seconds.

7. Switch the system off and disconnect the data cable from the blanking module.

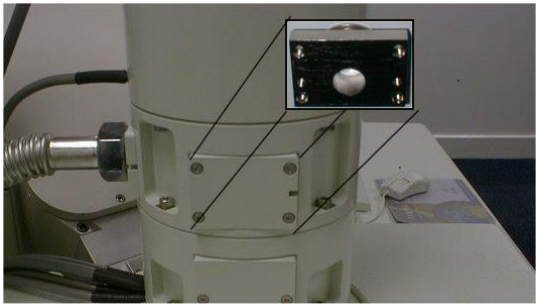
8. Remove the plastic protection tube from the blanking plates by loosening the fixing screws on the rear of the PCD Beam Blanker.



Note:

The cables connected to the PCD Blanker plates are fragile. When installing the PCD Beam Blanker into the microscope, take care not to catch the cables on the edge of the PCD port as this could cause cable damage.

For FEG columns the blanker will fit directly to the column, but for 5600/5900 style columns an adaptor plate as shown below will be required.



9. Fit the beam blanker and adaptor plate (if required) directly to the port using the M3 screws provided.

   When fitting the beam blanker, carefully insert the blanking module into the column, making sure it is straight and that you do not hit the aperture strip. Ensure that you have an o-ring fitted on each side of the column adaptor. Tighten using M4 screws. (If using an adaptor, tighten using M3 screw)

10. Re-insert the data cable, pump down and wait for vacuum ready. This beam blanking unit will have been tested on the Deben test JSM-840A for vacuum compatibility and the system will have been shipped with the plates in the out position.

Appendix – B - Testing

Set the SEM to 25KV HT.

Press BLANK and the plates will move from the out position to the blanking position. At this time the keypad display should say “Beam on” and an image should be visible.

If there is no image, adjust the plate position using the plate position arrow buttons until you see one, the position should be between 5.800 and 6.200 on the coordinate display. Once adjusted, the controller will remember the new position for future recall. Reset this position; to do this, press SETUP to show cords, followed by ENTER twice.

The plates are spaced 0.5mm apart and the outer plate (closest to the PCD unit) has a 0.25mm "knife edge" built into the bottom, which acts like an aperture in cutting off the beam. This gives a nominal beam path of around 0.25mm width.

To find the ideal blanking position:

1. Press blank and the plates will move into the blanking position.

2. Press the right PLATE POSITION arrow key and move the plates until the beam disappears, then

3. Move the plates back until the image just re-appears and then another 0.125mm with the left PLATE POSITION arrow key.

   The plates will now be in the optimum blanking position.

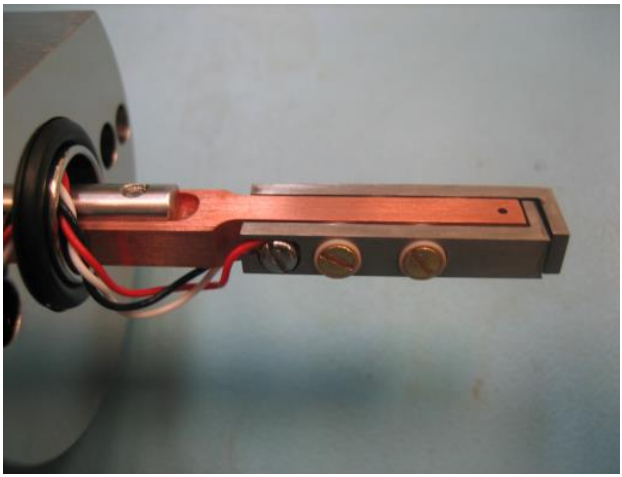
4. Press beam off and then beam on with the voltage set to at least 100V to make sure the beam can be correctly switched.

5. Apply a clock signal of a few Hertz into the pulse input on the power supply box and press blank, the image should switch on and off at the same frequency as the clock input.

Maximum clock frequency is 1.2MHz, a frequency limiting circuit is incorporated to protect the electronics from faster clock signals. If a signal faster than 1.2MHz is applied the clocking circuitry will automatically shut down.

Appendix – C - Maintenance

No routine maintenance is necessary, but after many hours of continuous use, especially at higher KV, contamination may occur on the plates. This could result in charging and can cause reduction in image quality.



To remove the plates, remove the two slotted screws retaining the red and black wires and remove brass screws holding the plates to the copper shaft.

Clean plates with IPA in an ultra-sonic bath. Re-assemble ensuring all spacers are replaced in the same positions correctly. The black wire should be connected to the end plate.

Appendix – D - Firmware reset

On systems with firmware version 3.03 or above, there is a reset facility built into the software.

Warning: Resetting your system will result in the loss of all stored positions.

It is therefore useful to make a note of the PCD and BLANK positions before doing a reset so that these can be setup again easily. To do this, press the 'PCD' key and wait for the stage to move into position. A quick press on the 'Plate position' left or right key causes the coordinate to be displayed. Make a note of this coordinate. Repeat this operation for the 'BLANK' position and make a note of the coordinate.

Now press the 'OUT' key to return the plates to 0.000mm.

If necessary, adjust the OUT position to be exactly 0.000mm.

Failure to do this step will result in the restored positions being invalid.

To reset, hold down the 'Plate Voltage ↓' key on the controller while turning on the power to the system. The display will briefly show 'Resetting…' and then return to normal operation.

Once reset is complete, the coordinates will need to be reset to their defaults. Press "SETUP" followed by "ENTER" twice to achieve this.

If the previous coordinates were recorded then it is now simple to restore them:

The reset function will have set OUT to 0.000mm, PCD to 10.000mm and BLANK to 6.000mm. Press BLANK to move the plates into position and use the Plate Position left and right keys to set the correct coordinates. Repeat this for the PCD position.

See page 9 for further information about setting up the plate positions.

Appendix – E - PCD/Blanker RS-232 control

Control software is supplied in the form of a 32-bit Dynamic Link Library (DLL) file (pcd.dll) written in Visual 'C'. This library file must be installed either in the same directory as the operating software or (Win95, Win98 or WinMe operating systems only) in the C:\WINDOWS\SYSTEM directory. A Visual Basic test program (source code and .exe file) can be supplied to confirm correct operation.

INITIALIZATION COMMANDS

InitRS232 - initialises PC RS232 COM port 1..4

Syntax - void InitRS232 (int port)

Parameter - port (1..4)

Note - communication parameters are pre-set to 9600 baud, 1 stop bit , no parity, with no handshaking.

CloseRS232 - closes PC RS232 COM port

Syntax - void CloseRS232 ()

Parameter - None

WRITE COMMANDS

SetPcdOut - drives PCD/blanker to the out position

Syntax - void SetPcdOut ()

Parameter – None

SetPcdPCD - drives PCD/blanker to the PCD position

Syntax - void SetPcdPCD ()

Parameter – None

SetPcdBlank - drives PCD/blanker to the blanking position

Syntax - void SetPcdBlank ()

Parameter - None

SetPcdBeamOn - Blanking position - turns beam on

Syntax - void SetPcdBeamOn ()

Parameter - None

SetPcdBeamOff - Blanking position - turns beam off

Syntax -void SetPcdBeamOff ()

Parameter - None

SetPcdBeamBlank - Blanking position - enables blanking pulses

Syntax - void SetPcdBeamBlank ()

Parameter - None

SetPcdResetCoords - Out position - resets position values to defaults

Syntax - void SetPcdResetCoords ()

Parameter - None

SetPcdBlankInvert - Blanking position - inverts blanking pulses

Syntax - void SetPcdBlankInvert ()

Parameter - None

SetPcdBlankNormal - Blanking position - does not invert blanking pulses

Syntax - void SetPcdBlankNormal ()

Parameter - None

SetPcdVolts - Blanking position – sets blanking voltage

Syntax - void SetPcdVolts (char *volts)

Parameter - string representation of volts (0 – 200)

SetPcdPosition - Changes blanker position

Syntax - void SetPcdPosition (char*microns)

Parameter - string representation of position change (-100 to 100)

SetPcdCalibration - PCD position – sets PCD calibration

Syntax - void SetPcdCalibration (char *cal)

Parameter - string representation of calibration factor (30 to 300), default = 100

READ COMMANDS

ReadPcdPosition - reads the position

Syntax - void ReadPcdPosition(char *s)
Parameter - buffer (min. 10 characters) for position string
Format : XX.XXX

ReadPcdVolts - reads the plate volts

Syntax - void ReadPcdVolts(char *s)
Parameter - buffer (min. 10 characters) for volts string
Format : XXX

ReadPcdCurrent - reads the PCD current

Syntax - void ReadPcdCurrent(char *s)
Parameter - buffer (min. 10 characters) for current string
Format : X.XX nA

ReadPcdStatus - reads the position, beam and move status
Syntax - void ReadPcdStatus(char *s)
Parameter - buffer (min. 10 characters) for status string

Format : ABC
A = “0” : position out
A = “1” : position PCD
A = “2” : position blanker
B = “0” : beam on
B = “1” : beam off
B = “2” : beam blanking
C = “0” : blanker stopped
C = “1” : blanker moving

Appendix F – Chinese RoHS Declaration

零件项目(名称) (Component Name)	有毒有害物质或元素(Hazardous Substances or Elements)					
	铅 Lead (Pb)	汞 Mercury (Hg)	镉 Cadmium (Cd)	六价铬 Chromium VI Compounds (Cr6+)	多溴联苯 Poly-brominated Biphenyls (PBB)	多溴二苯醚 Poly-brominated Diphenyl Ethers (PBDE)
Head Unit	O	O	O	O	O	O
Control Unit	X	O	O	O	O	O
Controller	O	O	O	O	O	O
Cables	O	O	O	O	O	O
Accessories	O	O	O	O	O	O

O: 表示该有毒有害物质在该部件所有均质材料中的含量均在 SJ/T 11363-2006标准规定的限量要求以下.

O: Indicates that this toxic or hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement in SJ/T11363-2006.

X: 表示该有毒有害物质至少在该部件的某一均质材料中的含量超出 SJ/T 11363-2006标准规定的限量要求.

X: Indicates that this toxic or hazardous substance contained in at least one of the homogeneous materials used for this part is above the limit requirement in SJ/T11363-2006.

除非另外特别的标注,此标志为针对所涉及产品的环保使用期标志.
此环保使用期限只适用于产品是在产品手册中所规定的条件下工作.

The Environmental Protection Use Period (EPUP) for all enclosed products and their parts are per the symbol shown here, unless otherwise marked. The Environmental Protection Use Period is valid only when the product is operated under the conditions defined in the product manual.

Appendix – G – Product Update Notification

DEBEN UK Limited
Brickfields Business Park
Old Stowmarket Road
Woolpit, Bury St. Edmunds
Suffolk IP30 9QS. UK.

Tel: 01359 244 870
Fax: 01359 244 879
E-Mail: info@deben.co.uk
Web: www.deben.co.uk

PRODUCT UPDATE NOTIFICATION

This change notification refers to the following products:
Coolstage, Sprite, Microtest, PCD Beam Blanker

Document reference: PUN5002
This document replaces PUN5001

Date issued: 20/06/2012

Notification:
The above mentioned products from Deben UK Ltd have Metal Oxide Varistors (MOVs) fitted between Live-Earth and Neutral-Earth of the incoming mains supply. The MOVs are fitted to perform the task of surge suppression, and will clamp any voltage over 300VAC. The energy of the surge is dissipated as heat. These devices are reusable and self resetting and do not normally require replacement after surge conditions.

Because of the method of operation of these devices, a standard PAT insulation test will normally fail since these are run at 500VDC which will trigger the devices. Therefore, PAT insulation tests must be run at a lower voltage or excluded from the test.

Further information:

Device part number: JVR-14N471K
Manufacturer: Joyin (http://www.joyin.com.tw)

Varistor Part No.	Maximum Allowable Voltage		Varistor Voltage V 1mA		Maximum Clamping Voltage	Withstanding Surge Current		Rated Wattage	Energy 10/1000us	Typical Capacitance	Dimensions	
	ACrms (V)	DC (V)	(V)	Tolerance Min - Max	V 10A (V)	1 Time (A)	2 Times (A)	(W)	(J)	1 KHz (PF)	D Max	T
JVR-14N471K	300	385	470	423 - 517	775	4500	2500	0.6	140.0	390	14φ	6.5

Issued by	Approved by
Ed Williamson-Brown	Mark Bramall
QC LEVEL 1 OK	
Date: 20/6/12	Date: 20/6/12